<u>AMENDMENTS TO THE SPECIFICATION</u>:

Please replace the heading appearing prior to Paragraph 1 with the following heading:

<u>CROSS-REFERENCE</u>~~CROSS-REFERENCED~~ TO RELATED APPLICATIONS

Please replace the disclosure contained in Paragraph 1 with the following rewritten disclosure:

The present application is related to Patent Application Serial No. <u>10/619,641</u>~~(Attorney Docket No. ARC9-2003-0014-US1)~~, entitled "Anamorphic Codes", Patent Application Serial No. <u>10/619,633</u>~~(Attorney Docket No. ARC9-2003-0016-US1)~~, entitled "Multi-path Data Retrieval From Redundant Array," and Patent Application Serial No. <u>10/619,648</u>~~(Attorney Docket No. ARC9-2003-0040-US1)~~, entitled "RAID 3 + 3" each co-pending, co-assigned and filed concurrently herewith, and each incorporated by reference herein. The present application is also related to co-pending and co-assigned Patent Application Serial No. <u>10/600,593</u>~~(Attorney Docket No. YOR9-2003-0069-US1)~~, which is also incorporated by reference herein.

Please replace the disclosure contained in Paragraph 22 with the following rewritten disclosure:

The advantages of the present invention are provided by a method for increasing failure tolerance of a storage system having a plurality of arrays such that each array has a plurality of storage units. The arrays of the storage system include redundancy based on an erasure or error correcting code, such as a parity code, a Winograd code, a symmetric code, a Reed-Solomon code, an EVENODD code or a derivative of an EVENODD code. The failure tolerance of a storage system is given by the minimum Hamming distance D of the system. The minimum <u>Hamming</u> distance of the system is, accordingly, the minimum of all the minimum Hamming distances of the respective stripes, that is, $D = \min(d_i)$. A donor array is selected from the plurality of arrays when the difference between a minimum <u>Hamming</u> distance of the donor array and a minimum <u>Hamming</u> distance of a recipient array is greater or equal to 2. A donor storage unit is selected in the donor array based on a minimal performance impact on the donor array. A

recipient storage unit is selected from the recipient array. At least a portion of lost information is then rebuilt from the recipient array onto the selected storage unit in the donor array. The recipient information is selected based on an improved performance of the recipient array. The selected storage unit is indicated to the donor array as having been donated before the lost information is rebuilt on the selected storage unit. Preferably, the minimum Hamming distance of the recipient array is $d \geq 2$ before the donor array is selected from the plurality of arrays. When a spare storage unit becomes available, the spare storage unit is assigned to a selected array in a conventional manner.

Please replace the disclosure contained in Paragraph 25 with the following rewritten disclosure:

Further still, the present invention provides a data storage system having a plurality of arrays and a system array controller. Each array has a plurality of storage units and includes redundancy based on an erasure or error correcting code, such as a parity code, a Winograd code, a symmetric code, a Reed-Solomon code, an EVENODD code or a derivative of an EVENODD code. The system array controller is coupled to each array and detects a failure of a storage unit in a first array of the plurality of arrays. The system controller then selects a storage unit in a second array of the plurality of arrays when a difference between a minimum Hamming distance of the second array and a minimum Hamming distance of the first array is greater or equal to 2. At least a portion of lost information from the first array is rebuilt onto the selected storage unit of the second array. Each storage unit can be an HDD, a volatile Random Access Memory device, a non-volatile Random Access Memory device, an optical storage device, or a tape storage device.

Please replace the disclosure contained in Paragraph 40 with the following rewritten disclosure:

APX allows arrays within a set of arrays to exchange redundancy, thereby overcoming exposure to failures that are concentrated on a single array of the set of arrays. For example, if a first array

Application Serial No. 10/619,649

has a minimum Hamming distance that is less than the minimum Hamming distance of a second array by 2 or more, the second array can donate a storage unit to the first array. Afterward, the failure tolerance of the first array will be increased and the failure tolerance of the second array will be reduced, but to a level that is not less than the first array. Accordingly, the minimum Hamming distance of the system will be increased, thereby increasing the failure tolerance of the system.

Please replace the disclosure contained in Paragraph 42 with the following rewritten disclosure:

Figure 1b shows an exemplary storage system, indicated generally as 150, comprising two storage arrays 153 and 154, each comprising multiple storage units 155, that are respectively connected to different array controllers 152 and 151. Storage array 153 communicates with array controller 152 over interface 157, and storage array 154 communicates with array controller 151 over interface 156. Array controllers 151 and 152 respectively communicate with other array controllers and storage systems over interfaces 158 and 159. Also shown in Figure 1b is a communication connection 160 that allows array controllers 151 and 152 to communicate with each other.

Please replace the disclosure contained in Paragraph 59 with the following rewritten disclosure:

APX can be used beyond simply increasing the minimum Hamming distance of a storage system. Many other factors may be included in determining whether to perform APX and to choose donors and recipients. For example, the individual failure probabilities of components when they are non-uniform, the combinations of failures that lead to data loss, and the effects on system performance may all be considered. In such cases, the minimum Hamming distance of the system could remain unchanged following APX.

Application Serial No. 10/619,649

Please replace the disclosure contained in Paragraph 60 with the following rewritten disclosure:

APX can be used with other array types having minimum Hamming distance $d \geq 3$. Additionally, a smaller array size allows APX to be used more efficiently, and allows large systems consisting of small arrays to achieve high failure tolerance. When a storage system has a spare pool, it is best to perform rebuilds onto the spare pool before performing an APX operation.

Please replace the Abstract of the Disclosure with the following rewritten Abstract of the Disclosure:

Error tolerance is increased for a storage system having a plurality of arrays by making local redundancy in a selected array globally available throughout the storage system. To achieve the increased error tolerance, a donor array is selected from the plurality of arrays when the difference between a minimum Hamming distance of the donor array and a minimum Hamming distance of a recipient array is greater or equal to 2. A donor storage unit is selected in the donor array and recipient information is then rebuilt from the recipient array on the selected storage unit. The selected storage unit is indicated to the donor array as having been donated before the lost information is rebuilt on the selected storage unit. Preferably, the minimum Hamming distance of the recipient array is $d \geq 2$ before the donor array is selected from the plurality of arrays.